

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:
a semiconductor element including an electrode part; and
5 a wiring substrate including:
an insulation layer;
an electrode-part-connection electrode provided in the
insulation layer; and
an external electrode that is provided in the insulation layer
10 and that is connected electrically with the
electrode-part-connection electrode,
the electrode part and the electrode-part-connection electrode
being connected electrically with each other,
wherein
15 the insulation layer has an elastic modulus of not less than 0.1 GPa
and not more than 5 GPa, and
the electrode and the electrode-part-connection electrode are
connected by metal joint.
- 20 2. The semiconductor device according to claim 1, wherein
the electrode part and the electrode-part-connection electrode include
metal layers made of at least one kind of metal selected from the group
consisting of noble metals and solder alloys, and
the metal layer of the electrode part and the metal layer of the
25 electrode-part-connection electrode are connected by metal joint.
3. The semiconductor device according to claim 1, wherein
the semiconductor element includes a plurality of the electrode parts,
and
30 a surface of the wiring substrate on a semiconductor element side and
a surface of the semiconductor element on a wiring substrate side are bonded
with each other so that spaces between the electrode parts are filled with the
insulation layer.
- 35 4. The semiconductor device according to claim 1, wherein a surface of
the wiring substrate crossing a thickness direction of the semiconductor
device perpendicularly is larger than a surface of the semiconductor element

crossing the thickness direction of the semiconductor device perpendicularly.

5. The semiconductor device according to claim 4, wherein the external electrode is arranged on a surface of the insulation layer that is seen when the semiconductor device is observed in the thickness direction thereof from a semiconductor element side.

6. The semiconductor device according to claim 1, wherein the wiring substrate further includes an inner via that is provided in the insulation layer so as to go through the insulation layer in a thickness direction thereof, and the electrode-part-connection electrode and the external electrode are connected electrically through the inner via.

7. The semiconductor device according to claim 6, wherein the wiring substrate further includes at least one wiring layer arranged in the insulation layer.

8. The semiconductor device according to claim 1, wherein the insulation layer is made of a material containing a thermosetting resin.

9. The semiconductor device according to claim 8, wherein the material containing a thermosetting resin contains 75 wt% to 91 wt% of an inorganic filler, and 9 wt% to 25 wt% of a resin composition containing a thermosetting resin.

10. The semiconductor device according to claim 9, wherein the thermosetting resin contains at least one kind of resin selected from the group consisting of epoxy resins, phenol resins, cyanate resins, and thermosetting polyimide.

11. The semiconductor device according to claim 10, wherein in the case where the material containing the thermosetting resin does not contain thermosetting polyimide, the material containing the thermosetting resin contains a thermosetting resin with a glass transition temperature of not higher than 150°C.

12. The semiconductor device according to claim 1, wherein the semiconductor element has a thickness of not less than 30 μm and not more than 100 μm .
- 5 13. The semiconductor device according to claim 1, wherein the insulation layer has a thickness of not less than 30 μm and not more than 200 μm .
14. The semiconductor device according to claim 1, wherein the semiconductor device has a thickness of not less than 60 μm and not more
10 than 300 μm .
15. A method for manufacturing a semiconductor device, comprising the step of:
- 15 superposing a mounting member and a semiconductor element including an electrode part, the mounting member including:
- an insulation member made of a material containing a resin;
- an electrode-part-connection electrode provided in the insulation member; and
- 20 an external electrode provided in the insulation member and connected electrically with the electrode-part-connection electrode,
- and bonding the electrode part and the electrode-part-connection electrode so that the mounting member and the semiconductor element are integrated,
- 25 wherein
- in the step, the electrode part is prepared so as to include a metal layer, the electrode-part-connection electrode is prepared so as to include a metal layer, and the metal layer of the electrode part and the metal layer of the electrode-part-connection electrode are connected by metal joint.
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16. The method for manufacturing a semiconductor device according to claim 15, wherein
- in the step, the insulation member is formed with a material containing a thermosetting resin in a non-cured state, and the mounting
35 member and the semiconductor element that are superposed are subjected to heat and pressure so that the thermosetting resin is cured.

17. The method for manufacturing a semiconductor device according to claim 16, wherein the step further includes a sub-step of, after curing the thermosetting resin, heating the metal layer of the electrode part and the metal layer of the electrode-part-connection electrode using ultrasonic
5 vibration.

18. The method for manufacturing a semiconductor device according to claim 15, wherein in the step, the metal layer of the electrode part and the metal layer of the electrode-part-connection electrode are formed with at least
10 one kind of metal selected from the group consisting of noble metals and solder alloys.

19. The method for manufacturing a semiconductor device according to claim 16, wherein the step includes sub-steps of preparing a transfer carrier
15 provided with a wiring pattern, superposing the transfer carrier provided with the wiring pattern and the insulation member so that the wiring pattern and the insulation member are brought into contact with each other, and removing only the transfer carrier from the insulation member, so that the electrode-part-connection electrode is formed on the insulation member.

20. The method for manufacturing a semiconductor device according to claim 16, wherein the step includes sub-steps of filling a conductive material
20 inside the insulation member, providing the electrode-part-connection electrode on a surface of the insulation member on one side thereof, and providing the external electrode on the other surface of the insulation member on an opposite side thereof, so that the mounting member is formed.

21. The method for manufacturing a semiconductor device according to claim 20, wherein the step further includes sub-steps of preparing a plurality
30 of sheet-like materials that are made of the material containing a thermosetting resin in a non-cured state, that have through holes, and that are to become the insulation member when they are laminated, filling a conductive material in the through holes, and laminating the sheet-like materials in a manner such that a wiring layer is arranged between the
35 different sheet-like materials, so that the insulation member filled with the conductive material is prepared.

22. The method for manufacturing a semiconductor device according to claim 15, further comprising a step of processing the semiconductor element so that the semiconductor element has a thickness of not less than 30 μm and not more than 100 μm , the processing step being carried out after the mounting and bonding step.

23. The method for manufacturing a semiconductor device according to claim 16, wherein the material containing a thermosetting resin in a non-cured state contains 75 wt% to 91 wt% of an inorganic filler, and 9 wt% to 25 wt% of a resin composition containing a thermosetting resin.

24. The method for manufacturing a semiconductor device according to claim 23, wherein the thermosetting resin contains at least one kind of resin selected from the group consisting of epoxy resins, phenol resins, cyanate resins, and thermosetting polyimide.

25. The method for manufacturing a semiconductor device according to claim 24, wherein in the case where the material containing the thermosetting resin in a non-cured state does not contain thermosetting polyimide, the material containing the thermosetting resin in a non-cured state contains a thermosetting resin with a glass transition temperature of not higher than 150°C.

26. A method for manufacturing a semiconductor device, comprising the steps of:

(a) superposing a mounting member and a semiconductor element material including a plurality of semiconductor elements having electrode parts, the mounting member including:

an insulation member made of a material containing a resin;

a plurality of sets of electrode-part-connection electrodes provided on a surface of the insulation member on one side thereof; and

a plurality of sets of external electrodes provided on a surface of the insulation member on an opposite side thereof, wherein the electrode-part-connection electrodes and the external electrodes are connected electrically with each

other,
and bonding the electrode parts and the electrode-part-connection electrodes,
so that the mounting member and the semiconductor element material are
integrated; and

5 (b) cutting the semiconductor element material and the mounting
member together so that the individual semiconductor elements are separated
from one another, the step (b) being carried out after the step (a),

wherein

10 in the step (a), the electrode parts are prepared so as to include metal
layers, the electrode-part-connection electrodes are prepared so as to include
metal layers, and the metal layers of the electrode parts and the metal layers
of the electrode-part-connection electrodes are connected by metal joint.

27. The method for manufacturing a semiconductor device according to
15 claim 26, wherein

in the step (a), the insulation member is formed with a material
containing a thermosetting resin in a non-cured state, and the mounting
member and the semiconductor element material that are superposed are
subjected to heat and pressure so that the thermosetting resin is cured.

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28. The method for manufacturing a semiconductor device according to
claim 27, wherein the step (a) further includes a sub-step of, after curing the
thermosetting resin, heating the metal layers of the electrode parts and the
metal layers of the electrode-part-connection electrodes using ultrasonic
25 vibration.

29. The method for manufacturing a semiconductor device according to
claim 26, further comprising a step of processing the semiconductor elements
so that the semiconductor elements have a thickness of not less than 30 μm
30 and not more than 100 μm each, the step being carried out after the step (a)
and prior to the step (b).

30. The method for manufacturing a semiconductor device according to
claim 26, wherein in the step (a), the metal layers of the electrode parts and
35 the metal layers of the electrode-part-connection electrodes are formed with at
least one kind of metal selected from the group consisting of noble metals and
solder alloys.

31. The method for manufacturing a semiconductor device according to claim 27, wherein the step (a) includes sub-steps of preparing a transfer carrier provided with a wiring pattern, superposing the transfer carrier
5 provided with the wiring pattern and the insulation member so that the wiring pattern and the insulation member are brought into contact with each other, and removing only the transfer carrier from the insulation member, so that the electrode-part-connection electrodes are formed on the insulation member.

10 32. The method for manufacturing a semiconductor device according to claim 27, wherein the step (a) further includes sub-steps of preparing a plurality of sheet-like materials that are made of the material containing a thermosetting resin in a non-cured state, that have through holes, and that
15 are to become the insulation member when they are laminated, filling a conductive material in the through holes, and laminating the sheet-like materials in a manner such that a wiring layer is arranged between the different sheet-like materials, so that the insulation member filled with the conductive material is prepared.

20 33. The method for manufacturing a semiconductor device according to claim 27, wherein the material containing a thermosetting resin in a non-cured state contains 75 wt% to 91 wt% of an inorganic filler, and 9 wt% to 25 wt% of a resin composition containing a thermosetting resin.

25 34. The method for manufacturing a semiconductor device according to claim 33, wherein the thermosetting resin contains at least one kind of resin selected from the group consisting of epoxy resins, phenol resins, cyanate resins, and thermosetting polyimide.

30 35. The method for manufacturing a semiconductor device according to claim 34, wherein in the case where the material containing the thermosetting resin in a non-cured state does not contain thermosetting polyimide, the material containing the thermosetting resin in a non-cured
35 state contains a thermosetting resin with a glass transition temperature of not higher than 150°C.